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ORIGINAL ARTICLE

Cephalometric Evaluation of Influence of Edentulousness on Mandibular Morphology: A Comparative Study

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Abstract Mandible undergoes several dimensional changes due to aging accompanied with gradual loss of teeth. There is marked alterations in shape and dimensions of the parts of the mandible associated with complete or nearly complete loss of dentition. The purpose of this study was to analyze the effect of loss of dentition on the dimensions of mandible using lateral cephalogram. The study group comprised of 35 dentulous subjects (age range 25–30 years) and 35 edentulous subjects (age range 45–65 years), with a period of edentulousness of 1–5 years. Subjects were selected based on certain selection criteria and lateral cephalograms were taken. Lateral cephalograms were traced and the values obtained were statistically analyzed using T test. On statistical analysis it was found that the thickness of condylar process and corpus were reduced in edentulous subjects. Length of mandible, ramus and corpus were reduced in edentulous subjects when compared to dentulous subjects. Gonial angle was more obtuse in edentulous subjects. Reduction in thickness of condylar length and length of mandible were negatively correlated to duration of e-dentulousness. It can be concluded that mandible undergoes significant dimensional changes as a result of loss of teeth.

Keywords Corpus · Gonial angle · Gnathion · Remodeling changes

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Introduction

Shape of the mandible correlates with occlusal condition and functions of the masticatory muscles. Thus, in adults, mandible undergoes various morphological changes which are influenced by the occlusal status and age of the subjects. Various studies have shown that remodeling of mandible occurs with age and loss of dentition [1–5]. Distribution of remodeling fields in the edentulous mandible differs from that in the young, growing mandible. Due to progressive loss of teeth, the functional and structural relationships of the mandible changes which include altered occlusal relationships, rotations of the entire mandible, realignment of the mandibular corpus, redesign of the morphology of the corpus, altered muscle- to-bone alignments, changes in locations of muscle attachments and changes in regional form and size of the mandible in response to some or all of these altered functional relationships [4]. Thus the aim of this study was to evaluate the morphological alterations of the mandible during edentulousness using lateral cephalogram.

Materials and Methods

Study group comprised of 35 dentulous and 35 edentulous subjects, in the age range of 25–30 years for dentulous subjects and 45–65 years for edentulous subjects. The inclusion criteria for dentulous subjects were having Angle's class I molar relation, skeletal class I relation with full dentition and subjects without any history of previous periodontal disease and orthodontic treatment. Edentulous subjects who were completely edentulous for duration of 1–5 years were selected. The exclusion criteria for dentulous and edentulous subjects were subjects with any signs and symptoms of

temporomandibular dysfunction and history of trauma to the jaws. Systemic diseases excluded in the selection were diabetes mellitus, metabolic bone diseases such as osteomalacia, osteosclerosis and osteoporosis, degenerative bone diseases.

The data were obtained by recording case history, questionnaire and clinical examination. All subjects gave written informed consent to participate in the study and Yenepoya research centre and Yenepoya university ethics committee approved the study protocol. The study was conducted from February 2011 to May 2011 for a duration of 4 months.

Lateral cephalograms were taken for both dentulous and edentulous subjects.

All the cephalometric landmarks were traced on an acetate film of .003 inch thickness on top of an X-ray view box with .5 mm HB lead pencil. Following reference points and lines were traced on the lateral cephalogram, shown in Fig. 1:

Condylion-(Co): The most superior point on the head of the condyle
Gonion-(Go): The constructed point of intersection of ramus plane and mandibular plane
Gnathion-(Gn): The most anteroinferior point on the symphysis of the chin [6]

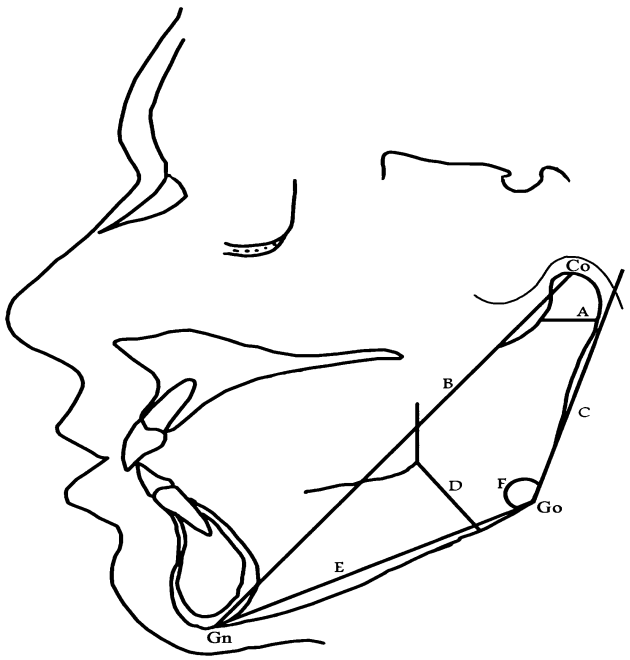

Fig. 1 *A* Thickness of condylar process—the shortest distance between the anterior and posterior surfaces of condylar process. *B* Length of mandible in lateral view. *C* Length of ramus—distance from the point Gonion to the superior condylar surface. *D* Thickness of corpus—the shortest distance between the superior and inferior surfaces of mandibular corpus. *E* Length of corpus—distance from the point Gnathion to the point Gonion. *F* gonial angle

Gnathion-(Gn): The most anteroinferior point on the symphysis of the chin [6]
Length of mandible in lateral view (B): Distance from point condylion to gnathion
Length of ramus (C): Distance from point gonion to superior condylar surface
Thickness of corpus (D): Shortest distance between the superior and inferior surface of mandibular corpus [3]
Gonial angle (F): Line drawn tangential to the most inferior point at gonion and the lower border of the mandibular body, and another line tangential to the posterior borders of the ramus and the condyle. The intersection of these two lines formed the gonial angle [1]

After tracing, measurements were recorded using a metallic millimeter ruler and protractor. The values obtained from dentulous and edentulous subjects were tabulated. The values obtained were analyzed statistically using T test.

Results

Cephalometric analyses regarding the remodeling changes of mandible are shown in Tables 1, 2 and 3. It was found that thickness of condylar process was significantly thinner ($p < .0005$) in edentulous subjects compared to dentulous subjects. Mandible was significantly shorter ($p < .0005$) in edentulous subjects. Length of the ramus and length of corpus were also significantly reduced ($p < .0005$) in edentulous subjects. Thickness of corpus was significantly reduced ($p < .0005$) in edentulous subjects compared to dentulous subjects (Figs. 2, 3).

Edentulous subjects had significantly larger gonial angles ($p < .0005$) compared to dentulous subjects. Thus statistically significant differences could be seen in dimensions of the mandible in edentulous subjects compared to dentulous subjects (Fig. 4).

The edentulous period correlated negatively (Tables 4, 5) to the thickness of the condylar process ($r = -.154$) and also to the length of the ramus ($r = -.135$).

Discussion

There is considerable mandibular growth during the first and second decade of life and mandible undergoes further secondary remodeling changes which can last into old age. During an individual's life, the morphological changes undergone by mandible are thought to be influenced by dental status and age of the patient [2].

Enlow et al. [4] described the remodeling of edentulous mandible in which there is deposition on the surface of the

Table 1 Cephalometric analysis regarding the thickness of condylar process in dentulous and edentulous subjects

	Group	N	Mean	S.D.	Mean difference	*p*
Thickness of condylar process	Dentulous	35	7.94	.938	2.114	<.0005
	Edentulous	35	5.83	1.098		

Table 2 Cephalometric analysis regarding the length of mandible, length of ramus, thickness of corpus and length of corpus in dentulous and edentulous subjects

	Group	N	Mean	S.D.	Mean difference	*p*
Length of mandible (cm)	Dentulous	35	11.81	.237	.317	<.0005
	Edentulous	35	11.50	.367		
Length of the ramus (cm)	Dentulous	35	6.231	.2687	.6943	<.0005
	Edentulous	35	5.537	.2211		
Thickness of corpus (cm)	Dentulous	35	2.557	.1899	.9457	<.0005
	Edentulous	35	1.611	.1641		
Length of the corpus (cm)	Dentulous	35	6.30	.612	.531	<.0005
	Edentulous	35	5.77	.587		

Table 3 Cephalometric analysis of gonial angle in dentulous and edentulous subjects

	Group	N	Mean	S.D.	Mean difference	*p*
Gonial angle	Dentulous	35	120.46	1.559	5.400	<.0005
	Edentulous	35	125.86	1.004		

basal bone of the medial and lateral side of the corpus. Bone undergoes resorption on the buccal and lingual side of the overlying alveolar region. The lateral side of the ramus and posterior half of the lingual side undergo resorption. As the posterior border of the ramus undergoes resorption, the postero-anterior dimension of the ramus becomes reduced and narrowed in conjunction with resorption along the anterior border. Thus the edge of the gonial angle moves anteriorly and superiorly because of resorptive field on its posterior and inferior side [3].

Subcondylar region on the anterior side of the neck of the condyle is resorptive. This produces a depression which accommodates the articular tuberosity of the glenoid fossa during edentulous closure of the mandible [4]. Thus in the present study thickness of the condylar process was reduced in edentulous subjects compared to dentulous subjects.. But the edentulous period correlated negatively

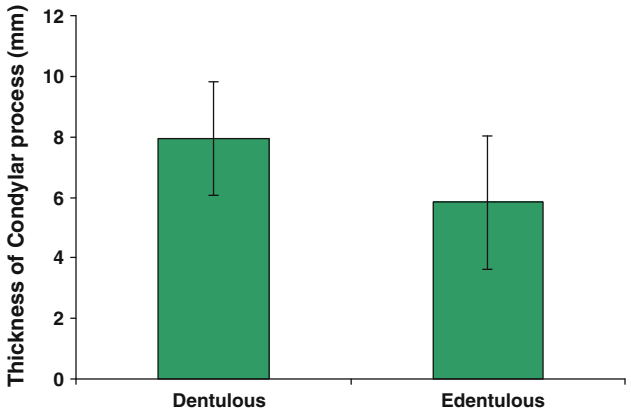

Fig. 2 Comparison of mean thickness of condylar process in dentulous and edentulous subjects

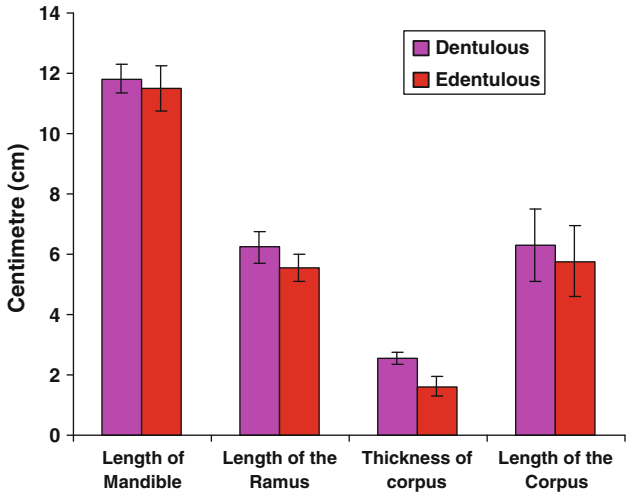

Fig. 3 Comparison of mean lengths of mandible, ramus, thickness of corpus and length of corpus in dentulous and edentulous subjects

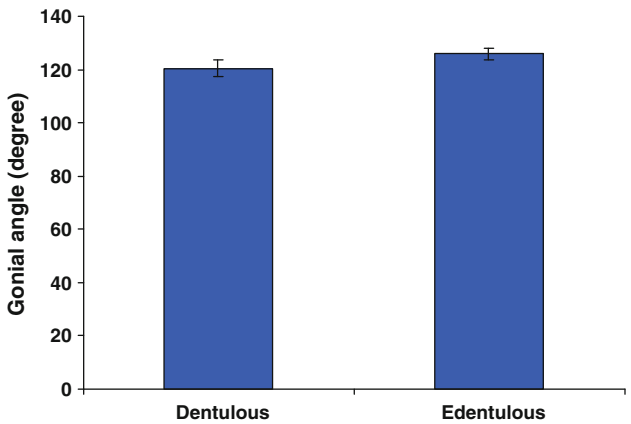

Fig. 4 Comparison of mean gonial angle in dentulous and edentulous subject

Table 4 Correlation regarding the thickness of condylar process in edentulous subjects

		Thickness of condylar process edentulous (mm)
Duration of edentulousness (years)	Pearson correlation	−.154
	p	.377
	N	35

Table 5 Correlation regarding the length of ramus in edentulous subjects

		Length of the ramus
Duration of edentulousness (years)	Pearson correlation	−.135
	p	.441
	N	35

to the thickness of the condylar process which is consistent with the study conducted by Raustia et al. [3].

In the edentulous state, there is deposition of bone on the surface of the basal bone on both the medial and lateral sides of the corpus, but resorption takes place on the alveolar regions on both the lingual and buccal sides [4]. Thus the thickness and length of the corpus was reduced in edentulous subjects when compared to dentulous subjects.

Enlow et al. [4] in their study regarding the remodeling of the edentulous mandible stated that both the posterior and anterior borders of the ramus are resorptive in nature. This narrows the postero-anterior breadth of the ramus, thus the length of ramus was reduced in edentulous subjects compared to dentulous, which is in consistent with the study conducted by Huumonen et al.[1] and it correlated negatively with the duration of edentulousness [3].

Presence of bone resorption on the lingual side of the gonial region along with the deposition on the buccal side produces a flaring and buccal protrusion of this region. Masseter and medial pterygoid muscles are inserted into the region of the gonial angle. Thus the contraction of these muscles influences the shape of the mandibular basal bone [7, 8]. Electromyography studies have shown strong masseter and anterior temporal muscle activities are associated with larger posterior facial height and a small gonial angle in dentulous subjects [9, 10]. As masticatory muscle function decreases with the loss of teeth in edentulous subjects the gonial angle becomes wider compared to dentulous subjects which has also been noted in earlier studies [1, 3, 8, 10, 11].

Since vertical and horizontal magnification in the lateral cephalometric radiographs are known and the images of the jaws are well produced and various landmarks could be traced accurately measurements made from lateral cephalograms were preferred. However recent advances like digital subtraction radiography, computerized tomography and magnetic resonance imaging may be methods that will offer more detailed and accurate information regarding the remodeling changes of the edentulous mandible. Thus further studies should be carried out using these recent techniques for better understanding of the remodeling changes of edentulous mandible.

As a consequence of loss of teeth morphology of mandibular basal bone undergoes several changes. The findings of the present study signify the importance of prosthodontic treatment for well functioning of the masticatory muscles. For elderly edentulous patients prosthetic rehabilitation, either conventional or implant retained prosthesis should be encouraged to improve the functioning of the masticatory muscles.

Conclusion

Within the limitation of the present study and on the basis of results obtained, it was concluded that:

1. Thickness of the condylar process was reduced in edentu lous subjects when compared to dentulous subjects. Reduction in thickness was negatively correlated with the duration of edentulousness.
2. The lengths of mandible, ramus as well as the length of corpus were reduced in edentulous subjects. There was also a reduction in thickness of corpus in edentulous subjects when compared to dentulous subjects.
3. Reduction in length of the ramus was negatively correlated to the duration of edentulousness.
4. Edentulous subjects had a larger gonial angle when compared to the dentulous subjects.

Thus it was concluded that significant dimensional changes occur in mandible due to loss of dentition.

References

1. Huumonen S, Sipila K, Haikola B, Tapio M, Soderholm A-L et al (2010) Influence of edentulousness on gonial angle, ramus and condylar height. J Oral Rehabil 37:34–38
2. Dutra V, Yang J, Delvin H, Serin C (2004) Mandibular bone remodelling in adults: evaluation of panoramic radiographs. Dentomaxillofac Radiol 33:323–328
3. Raustia AM, Pirttiniem P, Salonen MAM, Phytinen J (1998) Effect of edentulousness on mandibular size and condyle-fossa position. J Oral Rehabil 25:174–179
4. Enlow DH, Bianco HJ, Eklund S (1976) The remodeling of the edentulous mandible. J Prosthet Dent 36:685–695

5. Tallegren A (1972) The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed longitudinal study covering 25 years. J Prosthet Dent 27:120–126
6. Athanasiou AE (1995) Orthodontic cephalometry, vol 1. Mosby-Wolfe, London, pp 21–49
7. Potgieter PJ, Monteith BD (1983) KempPL: the determination of free-way space in edentulous patients—a cephalometric approach. J Oral Rehabil 10:283–293
8. Xie QF, Ainamo A (2004) Correlation of gonial angle size with cortical thickness, height of mandibular residual body and duration of edentulism. J Prosthet Dent 91:477–482
9. Ingervall B, Thilander B (1974) Relation between facial morphology and activity of masticatory muscles. J Oral Rehabil 1(2):131–147
10. Casey DM, Emrich LJ (1988) Changes in the mandibular angle in the edentulous state. J Prosthet Dent 59:373–380
11. Ohm E, Silness J (1999) Size of the mandibular jaw angle related to age, tooth retention and gender. J Oral Rehabil 26:883–891